BULLETIN

A monthly bulletin of Advanced Manufacturing and Material Processing & Zecttron Sdn Bhd

Conducting World Class Research **April 2015 Issue 17**

DR MAYA AND RESEARCH TEAM

Visiting Professor, Major Events, Launching

DR MAYA's VISIT TO EPMB

19/3/2015 - Dr Siti Nurmaya Musa from AMMP Operations Research team together with her collaborations with Prof Mohd Omar from Institute of Mathematical Science, Faculty of Science UM and some organizing members of MISG from UTM (Prof Shah, Dr Zaitul and Dr Arina) visited EPMB Sdn Bhd in Batang Kali on 19th March 2015.The visit successfully identified potential industrial cases and success stories to be presented in the upcoming MISG Workshop in April 2015.

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News in Pictures

Launching Ceramony AutoDesk - Dr Farazila with student attending the launch ceramony Autodesk.

Social Event - social event celebration birthday Dr Sayuti , Mr Amir Farhan and Mdm Izatul Nadia.

Upcoming Events

PROFESSOR DR. MOHD HAMDI is a Professor at the Faculty of Engineering. He was a former Deputy Vice Chancellor for Academic and International in University of Malaya. With more than 20 years experience, he has strategized transformation in the academics and has significantly pushed the university to greater heights. Prof Hamdi has had great successes in commercialization of research activities.

For more information and registration please visit:

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Research Highlights

Sintering Behavior Of Synthesized Calcium Phosephate Of Biomedical Application.

By NATASHA NAWAWI.

Synopsis:

During the last several decades, Hydroxyapatite [HA, Ca10(PO4)6(OH)2] has attracted considerable attention for use in orthopedics and dentistry because of its structural and compositional similarity with natural bone. HA has been primarily used to form sintered body and polymer composites as replacements for bone and periodontal defects, dental materials, and maxillofacial implants. In fact, its biocompatibility and ability to bond with the surrounding tissues of HA have been experimentally proven to be superior to any other biomaterial. However, most synthetic apatites are formed via high temperature processes, resulting in a well-crystallized structure, which presents little or no activity toward bioresorption.

HA solubility increases from crystalline to amorphous and reduces crystal size, which are more advantageous in clinical applications. Hence, in recent years, interest in the synthesis of nanosized HA with grain size less than 100 nm has increased because of its high surface activity and enhanced bioresorption. Moreover, this ultrafine structure is similar to the mineral found in hard tissues and can readily promote osteointegration and subsequent bone tissue formation. In addition, given its greater surface area, nanocrystalline HA exhibits improved sinterability at lower temperatures resulting in a high density body couple with enhanced mechanical properties suitable for biomedical applications. Therefore, synthesis of crystalline hydroxyapatite (HA) nanoparticles with expected microstructure is of primary importance because the process directly relates to the phase purity, morphology, and particle size of the final HA particles.

In HA synthesis, precise control of crystal growth presents the utmost challenge because it directly relates to the size and the geometric shape of the final particles. These primary characteristics are widely documented to majorly affect mechanical properties, biocompatibility, and bioactivity. In general, the raw materials used to synthesize HA originate from commercial chemicals and natural sources. Naturally sourced HA involve extraction via heat treatment of animal cortical bones (bovine, pig, etc.) and natural waste (egg shell, clamshell), as well as conversion from marine coral derivatives to natural HA with acceptable porosity. HA preparation methods can technically be categorized into four groups, namely, dry methods (solid state synthesis, mechanochemical method), wet chemistry methods (wet chemical precipitation, hydrolysis method, sol–gel, hydrothermal, emulsion method, sonochemical method), high-temperature processes (combustion, pyrolysis), and combination procedures (hydrothermal–mechanochemical, hydrothermal–hydrolysis). Each method has been exclusively documented with their own advantages and significant results over the others.

The current research aims at synthesizing phase pure HA powders using synthetic precursors via wet chemical methods and natural source precursor (eggshell) via compaction and sintering method. In this research, there are two types of wet chemical methods involved in synthesizing HA that is wet chemical precipitation (HA-Wp) and sol-gel method (HA-Sg). Eggshell has been chosen as the source of Ca precursor due to its availability. Moreover, studies on eggshell derived HA (HA-Es) have been limited to the synthesis and characterization efforts on as-synthesized and sintered HA-Es samples whilst a full evaluation in terms of mechanical properties of sintered HA-Es samples have hardly been explored. Although mechanical strength of sintered E-HA samples have been reported previously, only the relative density and Vickers hardness were evaluated. Therefore, a thorough mechanical property evaluation of sintered E-HA sample is necessary.

Sintering studies via conventional pressureless sintering and microwave sintering were conducted on compacted as-synthesized HA in order to study their sinterability. Microwave heating is fundamentally different from the conventional one in which thermal energy is delivered to the surface of the material by radiation and/or convection heating that is transferred to the bulk of the material via conduction. In contrast, microwave energy is delivered directly to the material through molecular interaction with the electromagnetic field. Hence, it is possible to achieve rapid and uniform heating of thick materials which resulting in the potential to reduce processing time and enhance product quality as microwaves can transfer energy throughout the whole volume of the material. Futher analysis of various characterization techniques, such as X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectrometry and thermogravimetric/differential thermal analysis (TG/DTA) were conducted to observe HA phase stability. The morphology and particle size of the as-synthesized HA powders was determined via Field emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM) and Brunauer Emmett Teller (BET) Surface Area analyses were evaluated. Consequently, sintered HA compacts were assessed based on relative density, Vickers hardness and fracture toughness analysis. These properties were evaluated against the grain size of the sintered compacts and sintering temperature employed in

Training On High DC Power Supply

AMMP Centre organized a training of High DC Power Supply for students and Research Assistant. The training was held at AMMP Laboratory and were conducted by Mr Azhan from Tekmak.Sdn.Bhd to briefly explain regarding on the safety and handling the Autoranging DC Power Supply since this equipment is still unfamiliar. Hopefully, this new equipment would be a good potential in providing a great research in coating technology.

The AMMP Centre was established in 2002 with the aim of strengthening research activities in advanced manufacturing and material processes. The team has evolved from a small discussion platform of like-minded researchers to a fully operational research and consultation group in University of Malaya. Throughout the years, AMMP Centre has secured substantial research funding and commercialization grants from both local and international sources. For more information visit www.ammpcentre.com